A Follow-up Study of Closed Reduction of Congenital Dislocation of the Hip

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CITATION:

MORITA, SHIN ...[et al]. A Follow-up Study of Closed Reduction of Congenital Dislocation of the Hip. 日本外科宝函 1968, 37(3): 333-355

ISSUE DATE:

1968-05-01

URL:

http://hdl.handle.net/2433/207457

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A Follow-up Study of Closed Reduction of Congenital Dislocation of the Hip

by

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Received for Publication Feb. 15, 1968

Since Lorenz first reported his epoch-making method of conservative treatment of congenital dislocation of the hip in 1895, more than seventy years have elaspsed, and many reports on this problem have been published, some objecting to the original method and some advocations of it. After Floelich[9] discussed the end-results at the French Orthopaedic Congress in 1921, it turned out that the conservative treatment of the disorder by Lorenz's original method was not so satisfactory as had been expected at first. Since then many authors have described various improved methods, and early conservative treatment with later operative intervention for those not responding well has become the universal methode of choice. Although early treatment of the disorder in the new-born has recently met with fairly satisfactory results, secondary operative intervention in the prophylactic sense is still needed in not a few cases.

We much appreciate Lorenz's work as a great monument, but we cannot always agree with such a formalized method of treatment, since the disorder must be treated individually. The most important aspect of individual treatment is to evaluate the present state of the hip joint and also to estimate the fate of the reduced hip by roentgenograms during and after the course of the treatment.

The chief aim of this paper is to evaluate the early and intermediate results of conservative treatment of congenital dislocation of the hip in reference to the age of the patients. The fate of the reduced hip is estimated and the indications for prophylactic operation in cases with unsatisfactory results are also discussed.

MATERIAL AND GENERAL STATISTICS

Of the 1054 patients with congenital dislocation of the hip who were treated conservatively in Kyoto University Hospital from 1940 to 1955, 600 were reviewed. However, patients with cerebral palsy, poliomylitis, serious congenital club-foot and early reluxation were excluded, 904 joints in 585 patients were investigated (Tables I and II).

The age of the patients at the time of initial treatment ranged from one month to eleven years of age; the majority (86.1%) were under three years of age and more

than half (61%) under two years of age (Table III).

The period between the initial treatment and the follow-up examination ranged from one to nineteen years, and the patients were from one to twenty-four years of age at the time of re-examination (Tables IV and V).

Table I Percentage of Patients surveyed in this Study

Year of first treatment	Total No. of patients	No. of patients re-examined (%)
1940～1945	217	94 (43.3)
1946～1950	408	184 (45.0)
1951～1955	429	322 (76.1)
Total	1054	600 (56.9)

Table II Sex, Side and Incidence

Sex	Males	87 (14.9%)
	Females	497 (85.1%)
	Total	585
One or both sides	Unilateral	266 (45.5%)
	Bilateral	319 (54.4%)
	Total	585
Right or left sides	Right	431 (47.7%)
	Left	473 (52.3%)
	Total	904

Table III Age of Patients at Initial Treatment

Age in years	Under 1	1～2	2～3	3～5	5～10	10～12	Total
No. of patients	35	322	147	55	24	2	585
Per cent	6.0	55.0	25.1	9.4	4.1	0.4	100
No. of joints	54	487	238	87	35	3	904
Per cent	6.0	53.9	26.3	9.6	3.9	0.3	100

TREATMENT

Reduction :

Before 1950, manual reduction was done under general anaesthesia to move the femoral head over the posterior rim of the acetabulum. If the reduction was successful, a definite click ("Einrenkungsgeräusch") was felt in both hands. Some injury of the femoral head during the repositioning was unavoidable by this method. In order to minimize this injury,

Table IV Follow-up Interval

Interval (years)	No. of patients (Per cent)	No. of joints (Per cent)
1～2	108 (18.5)	175 (19.3)
2～3	101 (17.3)	161 (17.8)
3～5	140 (23.9)	213 (23.6)
5～10	148 (25.3)	219 (24.2)
10～15	66 (11.3)	102 (11.3)
15～20	22 (3.8)	34 (3.9)
Total	585 (100)	904 (100)

Table V Age of Patients at Re-examination

Age in years	1～2	2～3	3～5	5～10	10～15	15～20	20～25	Total
No. of patients	8	53	159	237	72	46	10	585
Per cent	1.4	9.1	27.2	40.5	12.3	7.9	1.7	100
No. of joints	13	85	250	360	113	69	14	904
Per cent	1.4	9.4	27.7	39.8	12.5	7.6	1.5	100

it was decided, thereafter, to employ a more gentle manipulation which had already been suggested by Takagi. The femoral head is always conducted through the "furrow" (termed "Gleitfurche" by Ludloff) into the acetabulum. In older children reduction was carried out after preliminary traction, but after 1951 open reduction was employed in these cases for the purpose of minimization of the head injury.

Fixation and Position :

The hip joint was immobilized for four to six months after reduction with a plaster cast in the flexed and abducted position of 90° as adovocated by Lorenz. However, avascular changes of the femoral head due to the unnatural frog-leg position and the long-term fixation occurred so easily that after 1951 a modified position was employed ; the hip joint was flexed and abducted less than 90° and the thigh was rotated inwards 30° for three months.

During the past several years, the majority of patients treated have been under three months of age. In these cases, the hip joint was immobilized with a plaster cast for one month, and then, a splint was applied for two to three months. In the new-born a splint of von Rosen's type was usually applied.

ASSESSMENT OF RESULTS

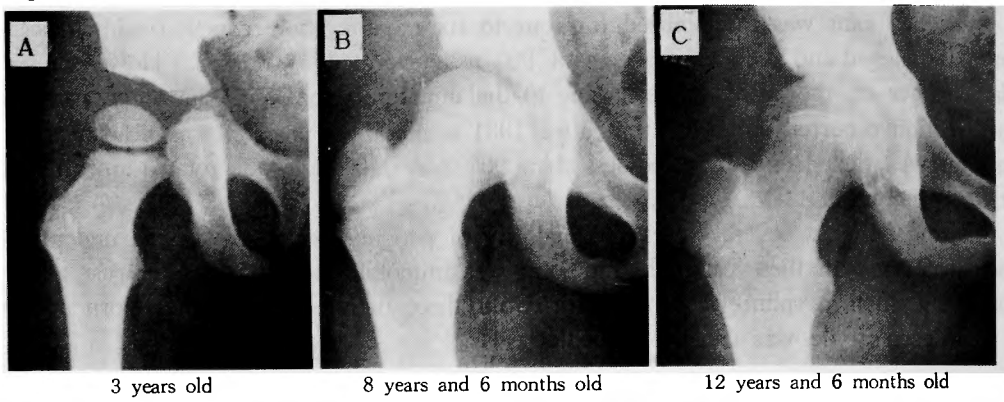
The point grading reported by Massie & Howorth and R. Merle d'Aubigné may be adequate for the evaluation of end-results. However, it is of little aid in judging early or intermediate results, since the method does not evaluate the findings in young children clearly enough to establish the prognosis in respect to the course or the degree of residual deformity. The condition of the hip joint itself is the most important factor in determining the indications for operation. Therefore, the simple criteria shown in Table VI were adopted.

Table VI Criteria for Assessment of Results

Results		Excellent	Good	Fair	Poor
Clinical	Subjective	Symptoms ; none	Tiredness after long walking ; none or slight	Some pain on movement ; none at rest	Pain on movement ; at rest
		Full movement	Full movement	Slight impairment of movement ; none fixed	Impairment of movement ; fixed
	Objective	Normal function	Normal or slight limitation of function	Slight or moderate limitation of function	Moderate or severe limitation of function
		No shortening of the leg	No shortening of the leg	Slight shortening of the leg	Shortening of the leg
Roentgenological		Almost normal	Dysplasia of the acetabular roof without dislocation	Subluxation	Dislocation or
			None or slight deformity of the femoral head	Slight or moderate deformity of the femoral head	Severe deformity of the femoral head

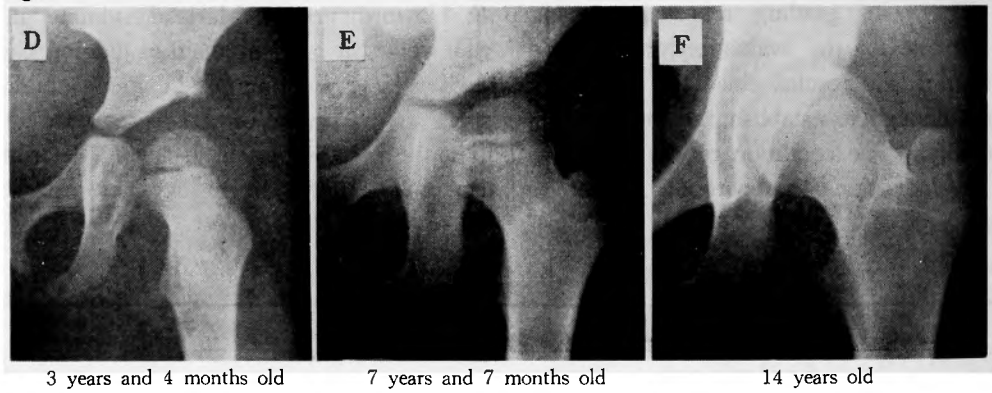
The roentgenological results were evaluated with the practical view of roentgenograms in each cases. The results in the bilateral cases were evaluated on the basis of the worse joint. Representative roentgenograms are shown in Figs. 1 - 3. A few patients treated after the age of ten years excluded from the present study because of uniformaly poor results.

Fig. 1 Excellent



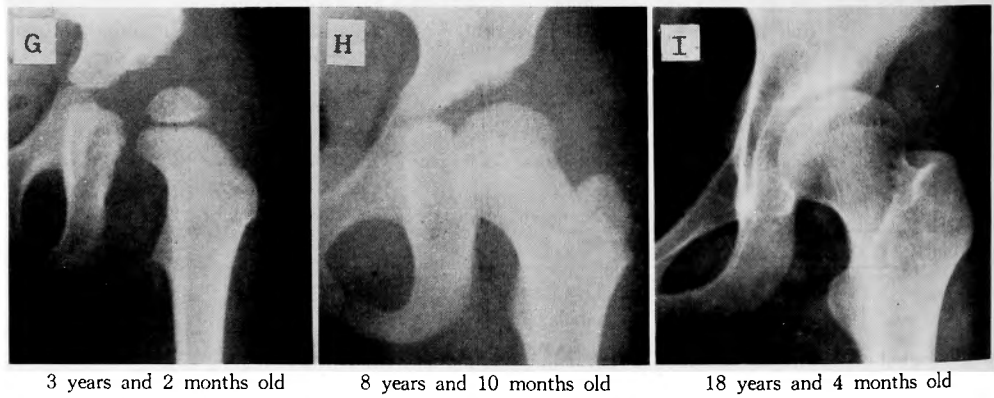
3 years old　　8 years and 6 months old　　12 years and 6 months old

Fig. 2 Good



3 years and 4 months old　　7 years and 7 months old　　14 years old

Fig. 3 Fair



3 years and 2 months old　　8 years and 10 months old　　18 years and 4 months old

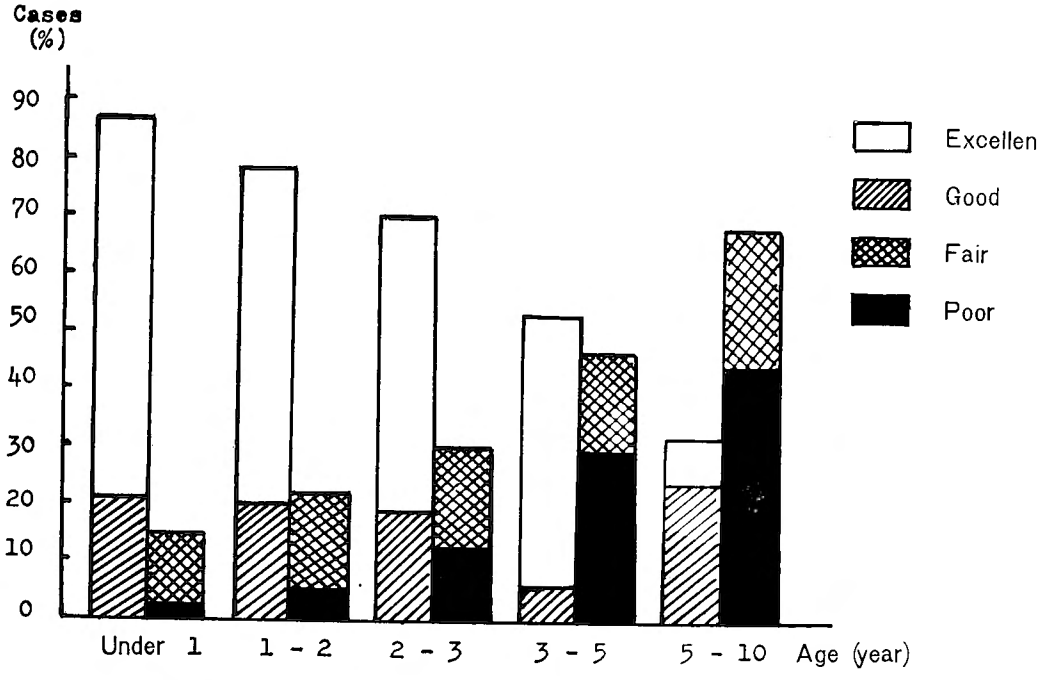
A, B, C, D, E and G were reduced under 2 years of age ; between 14 and 20 months. F, H and I were reduced at the age of 2 years.

CLINICAL AND ROENTGENOLOGICAL RESULTS

Clinical Findings:

Out of 568 cases, the clinical results were excellent in 305 cases (53.7%), good in 106 (18.7%), fair in 95 (16.7%) and poor in 62 (10.9%). The results were excellent in 65.8% when reduction was done before 1 year of age, in 47.1% of 3 and 4 years and in 8% of those over 5 years. The results were poor in 2.6% of those under 1 year of age and in 44% over 5 years (Fig. 4).

Fig. 4 Clinical Results related to Age at Initial Treatment



The older the patient at the time of the re-examination, fewer excellent results were obtained as noted in the re-examination of 873 joints. Furthermore, over half (61.5%) of those 15 years of age or older at the time of re-examination showed fair or poor results (Table VII).

Table VII Clinical Results in Relation to Age at Re-examination

Age (years) \ Results	Excellent	Good	Fair	Poor	No. of joints
1~3	71 (75.5%)	14 (14.9%)	5 (5.3%)	4 (4.3%)	94 (100%)
	(90.4%)		(9.6%)		
3~6	225 (68.4%)	58 (17.6%)	35 (10.6%)	11 (3.4%)	329 (100%)
	(86.0%)		(14.0%)		

Age (years) \ Results	Excellent	Good	Fair	Poor	No. of joints
6～10	157 (59.3%)	49 (18.6%)	37 (14.1%)	21 (8.0%)	264 (100%)
	(77.9%)		(22.1%)		
10～15	38 (36.9%)	28 (27.2%)	25 (24.3%)	12 (11.7%)	103 (100%)
	(64.1%)		(36.0%)		
15～24	21 (25.3%)	11 (13.3%)	34 (41.0%)	17 (20.5%)	83 (100%)
	(38.6%)		(61.5%)		
Total	512 (58.6%)	160 (18.3%)	136 (15.6%)	65 (7.4%)	873 (100%)
	(70.0%)		(23.0%)		

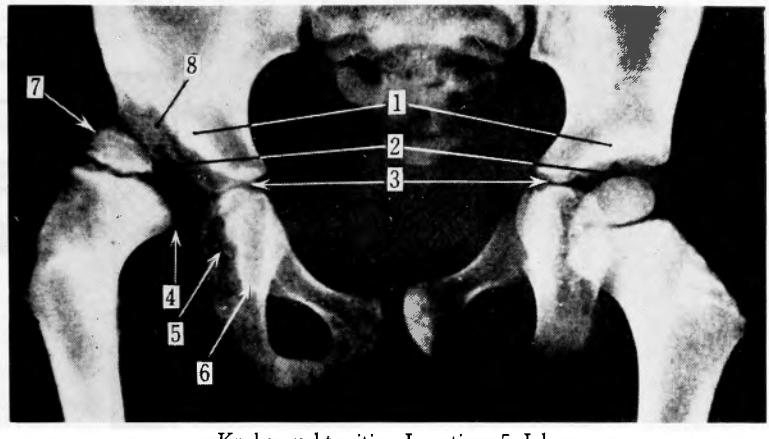
Roentgenological Findings:

The interpretation of roentgenograms of congenital dislocation of the hip is easy in adults, but difficult in young infants since the hip joint contains much cartilage. Mistakes were frequent in earlier articles. A serious error can be found in the illustration of Putti shown in Fig. 5. In 1937 Putti interpreted (1) as the anterior rim of the acetabulum and (2) as its posterior rim, while Rohlederer in 1950 stated that (2) is the image of the anterior acetabular rim but did not clearly denote (1). Before 1950 we had already, even with the simple roentgenograms at hand, considered (1) to be the image of the acetabular roof, since it is connected to the "furrow" ("Reibungsfurche" of Putti). This was later confirmed by arthrograms as in Fig. 6. The second error is found in the recognition of the lateral edge of the acetabular roof, i.e., in the determination of point E in the measurement of the acetabular angle (the α angle of Hilgenreiner) and the CE angle of Wiberg-Severin. In normal or slightly dysplastic hips of young infants the image of the anterior acetabular rim and that of the acetabular roof are exactly superimposed on the lateral edge of the acetabulum as shown in Fig. 7. However, in definitely dysplastic hips, each image always appears separately, as shown in Fig. 8. A similar view of the roentgenograms of dysplastic hips was already held by Deutschländer[2] in 1904 and also by Calot in 1920. The present investigations were carried out on the basis of the above-mentioned interpretation of roentgenograms.

The roentgenological results were much poorer than the clinical findings, and also bilateral cases showed much poorer results than unilateral. Among 568 cases, the roentgenological results were excellent in only 16 cases (2.7%), good in 173 (30.5%), fair in 329 (57.9%) and poor in 50 (8.8%).

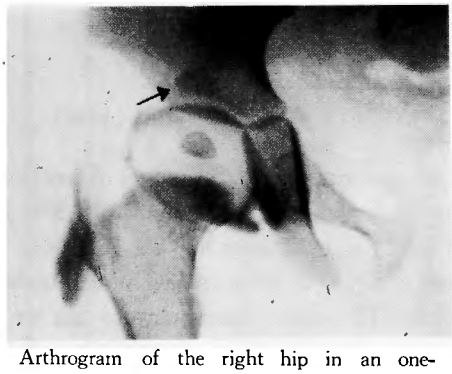
A marked difference was found in the results depending upon the age at the time of initial treatment, as shown in Fig. 9; excellent and good results were obtained in 63.4% of the cases reduced under 1 year of age, in 37.1% of those from 1 to 2 years, in 23.2% from 3 to 4 years, and in 5.4% over 5 years of age. Results were poor in

Fig. 5 Putti-Atlas by Rohlederer



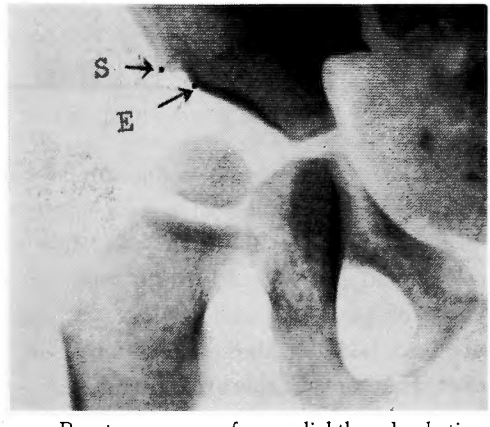
Knabe, rechtsseitige Luxation, 5 Jahre.
1. Ventraler Pfannenrand. 2. Dorsaler Pfannenrand. 3. Y-förmiger Knorpel. 4. Mediale Halsecke. 5. Pfannenhöhle. 6. Tränenfigur (Köhler). 7. Epiphysenkern. 8. Von Schenkelkopf in der Ala iliaca geschaffene Reibungsfurche.

Fig. 6



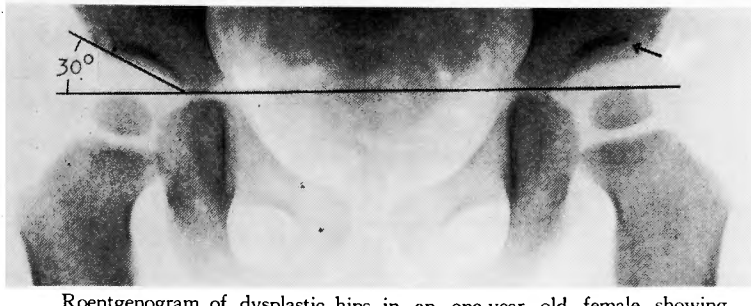
Arthrogram of the right hip in an one-year and four-month old male with left congenital dislocation of the hip, showing the image of the acetabular roof (arrow!)

Fig. 7



Roentgenogram of a slightly dysplastic hip in an one-year and four-month old female. The lateral edge of the acetabular roof and the spina iliaca anterior inferior are shown, respectively, by E and S (arrows!)

Fig. 8



Roentgenogram of dysplastic hips in an one-year old female showing determination of the E point (arrow!)

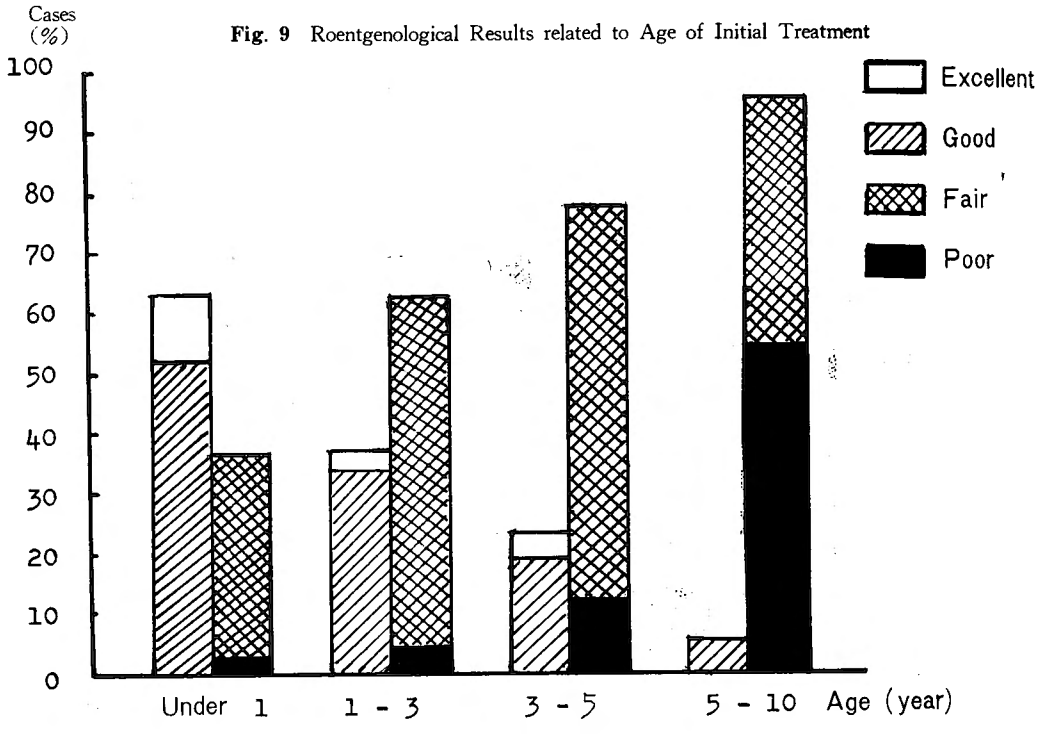


Fig. 9 Roentgenological Results related to Age of Initial Treatment

only 2.6% of the cases reduced under 1 year of age and in 54.5% over 5 years old.

The roentgenological results at the re-examination were excellent in 35 of 870 joints (4.0%), good in 323 (37.1%), fair in 454 (52.2%) and poor in 58 (6.7%). Excellent and good results were found in over about 40% of those re-examined under 14 years of age and in less than 30% of those over 15 years. Results were fair or poor in about 52% of those re-examined at 1 to 2 years of age and in about 74% of those over 15 years (Table VIII).

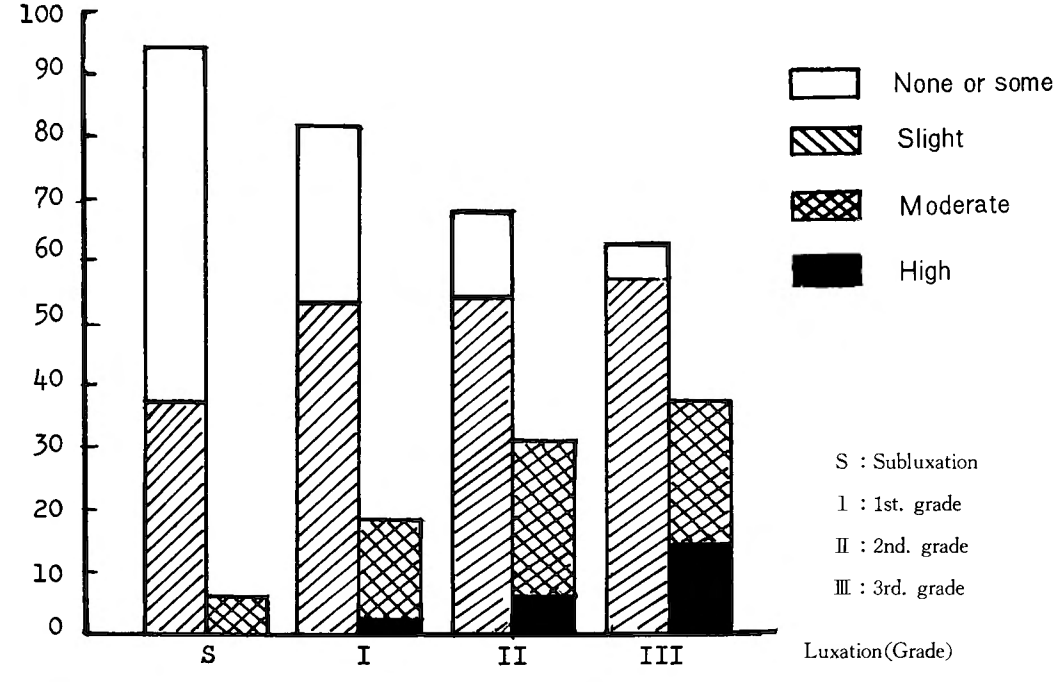
Table VIII Roentgenographic Results in Relation to Age at Re-examination

Age (years) \ Results	Excellent	Good	Fair	Poor	No. of joints
1～3	5 (5.4%)	40 (43.0%)	46 (49.5%)	2 (2.2%)	93 (100%)
	(48.4%)		(51.7%)		
3～6	7 (2.1%)	127 (38.6%)	186 (56.5%)	9 (2.7%)	329 (100%)
	(40.7%)		(59.2%)		
6～10	8 (3.1%)	108 (41.2%)	132 (50.3%)	14 (5.4%)	262 (100%)
	(44.3%)		(55.7%)		

10～15	10 1(9.7%)	31 (30.0%)	44 (42.7%)	18 (17.5%)	103 (100%)
	(39.8%)		(60.2%)		
15～24	5 (6.0%)	17 (20.5%)	46 (55.4%)	15 (18.1%)	83 (100%)
	(26.5%)		(73.5%)		
Total	35 (4.0%)	323 (37.1%)	454 (52.2%)	58 (6.7%)	870 (100%)

As to the deformity of the femoral head at the time of re-examination with reference to the grade of dislocation before treatment, it was noted that the higher the grade of dislocation the greater the degree of deformity (Fig. 10).

Fig. 10 Deformity of the Femoral Head at Examination in Relation to Grade of Luxation before Treatment



Avascular changes or osteochondritis of the femoral head were found in 37 (8.1%) of 454 cases. This disorder occurred much more often among cases treated in early infancy (Table IX). Osteochondritic deformities ("Luxations-Perthes") of the femoral head appeared in about 27% at 5 to 6 months after reduction, in about 51% after 7 to 12 months, in about 7% after 13 to 15 months, and were found in about 15 % after 2 to 10 years; i.e., the deformities occurred in the

Table IX Avascular Changes or Osteochondritis of the Femoral Head in Relation to Age at Initial Treatment

Age (years)	No. of cases examined	No. with avascular changes or osteochondritis	Per cent
Under 1	19	3	16.3
1～3	371	32	8.6
3～5	34	2	5.9
5～10	30	0	0
Total	454	37	8.1

majority of cases after the period of fixation or when the patients started to walk.

ROENTGENOGRAPHIC MEASUREMENT

The cases in which reduction was performed before 3 years of age were selected for this study in order to exclude those with high degree of deformity of the femoral head. They were divided into the following four groups, according to criteria for the assessment of results (Table VI) : 1) the so-called normal side in unilateral cases ("normal" hip), 2) almost normally healed hip ("normal-healed" hip), 3) dysplasia of the acetabulum without dislocation ("dysplasia" hip), and 4) subluxation-hip.

Acetabular Angle :

The acetabular angle in the 837 "normal" hips was ranged between 35° and 20° (average, 27.4°) in those under 1 year of age. Then it decreased gradually to 24°-10° (average, 15.2°) at puberty. The average value in those over 15 years of age was 14.2° (Fig. 11).

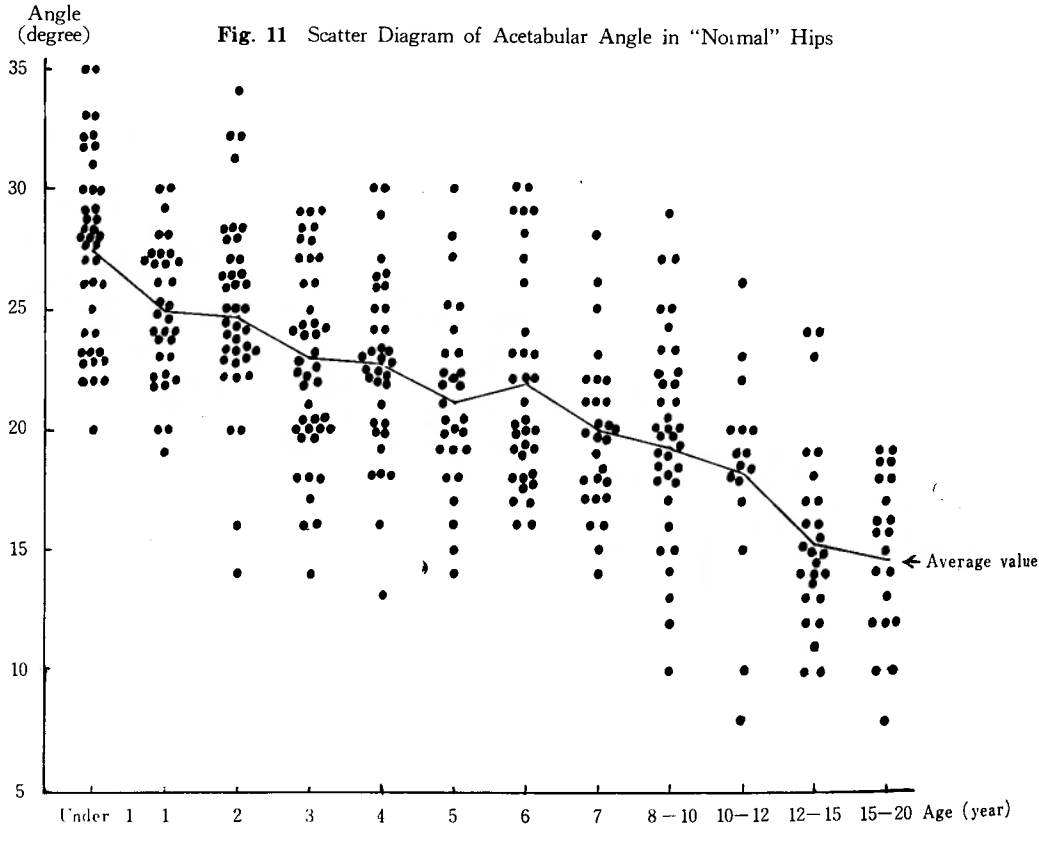


Fig. 11 Scatter Diagram of Acetabular Angle in "Normal" Hips

In the 343 "normal-healed" and "dysplasia" hips, the acetabular angle ranged between 38° and 22° in 1 to 3 years of age and then decreased to 29° - 10° at puberty. The curve of the average value ran nearly horizontally from 1 year of age (28.8°) to 3 years (29.8°) and then fell gradually until puberty (19.9°), after which it tended to rise slightly (Fig. 12).

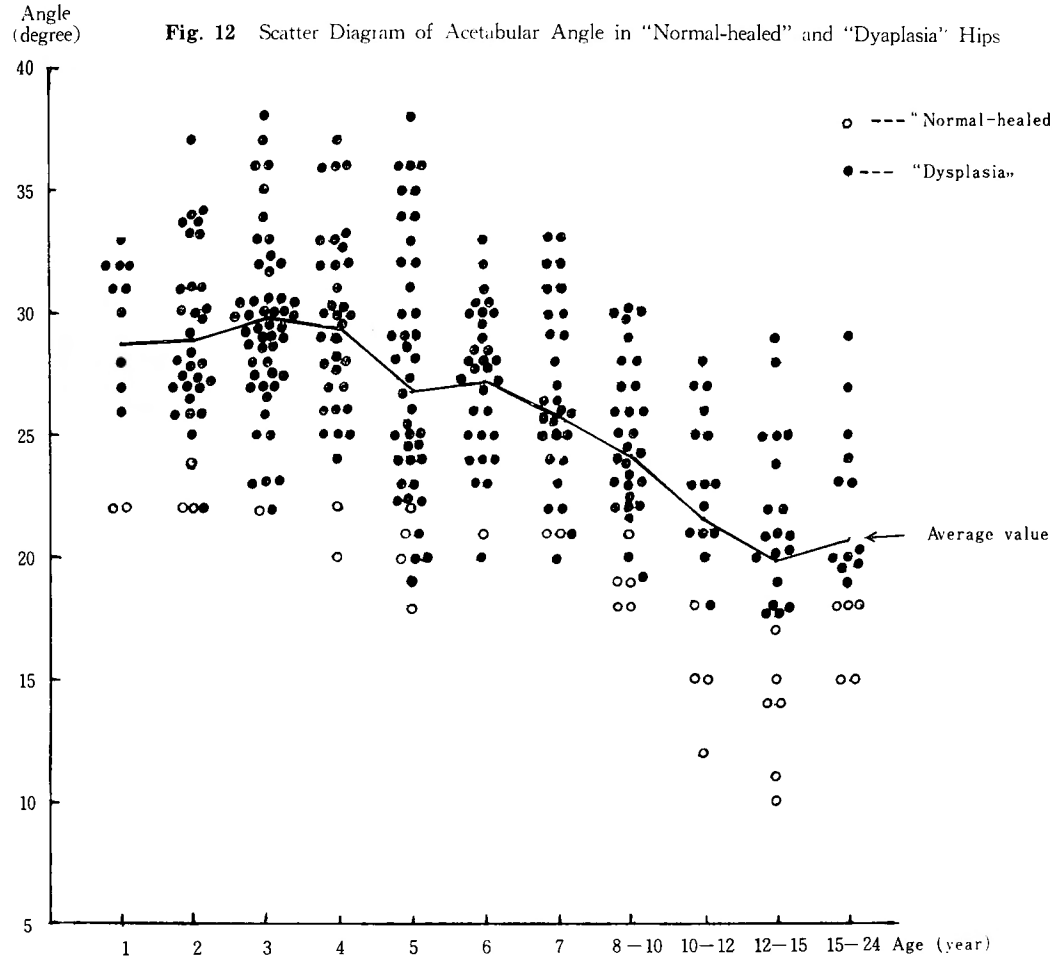


Fig. 12 Scatter Diagram of Acetabular Angle in "Normal-healed" and "Dyaplasia" Hips

In subluxation-hips, the distribution of the acetabular angle was very wide, ranging from 48° to 21° (average, 36.4° 29.3°), as shown in (Table X).

CE Angle:

The distribution of the CE angle in the 376 "normal" hips is shown in Fig. 13. It was found to range between 15° and −1° in those under 1 year of age, 16° - 0° in 1 year, 17° - 3° in 2 years, 26° - 4° in 3 to 9 years, and 31° 12° after puberty.

The CE angle in the 344 "normal-healed" and "dysplasia" hips was somewhat smaller than "normal" hips, and the average value increased slowly from 6.4° in those less than 1 year of age to 18.9° at puberty, after which it decreased to 16°, as shown in Fig. 14.

The range of dimensions of the CE angle in subluxation-hips was very wide in each age group, and the average value was inconsistent (Table XI).

Antetorsion:

Steward's fluoroscopic method was used to measure the antetorsion of the femoral neck.

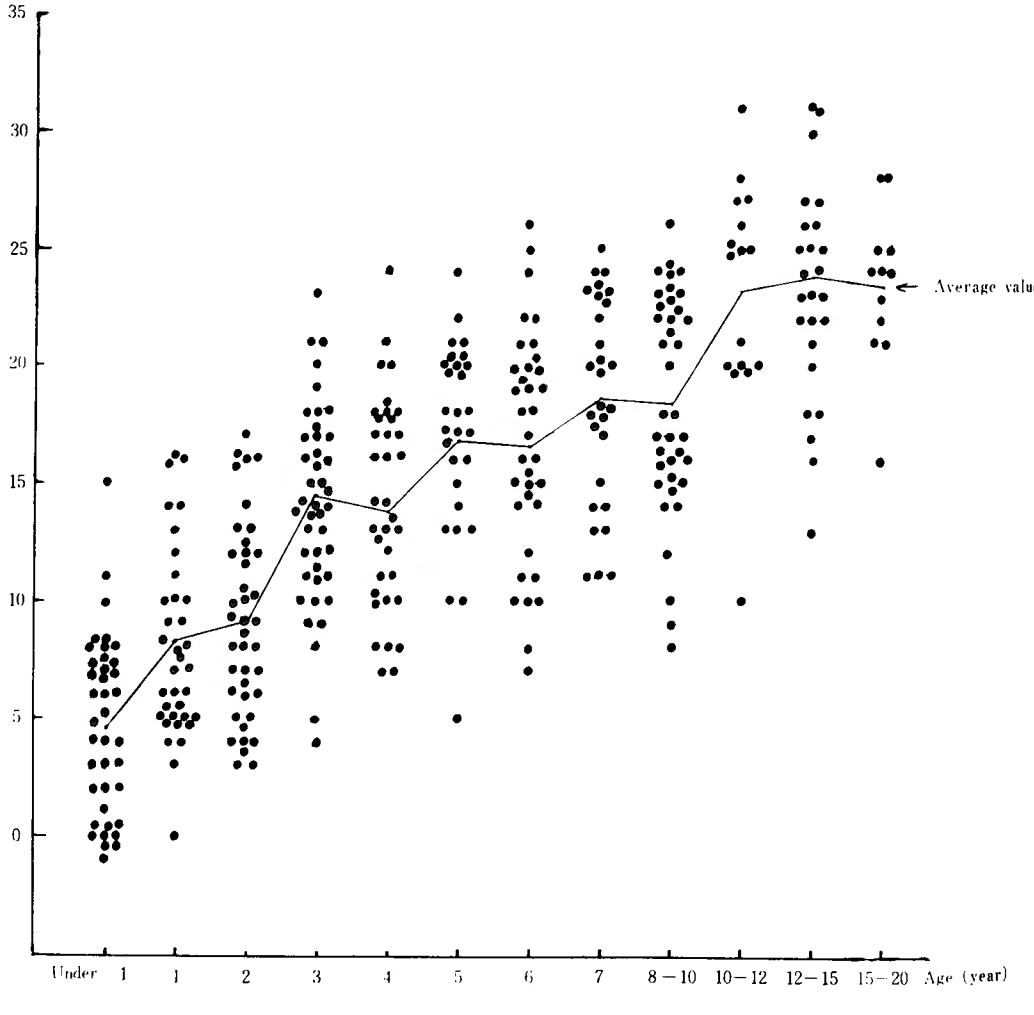
Table X
Acetabular Angle in Subluxation-Hips

Age in years	Number of joints	Range of distribution	Average value
1	3	32°～34°	33.3°
2	43	25°～46°	34.3°
3	83	27°～46°	35.4°
4	66	28°～46°	36.4°
5	34	28°～45°	35.5°
6	59	28°～45°	36.4°
7	38	24°～42°	34.5°
8～10	25	25°～46°	34.2°
10～12	17	23°～42°	33.5°
12～15	21	26°～48°	33.3°
15～20	18	21°～42°	29.3°

Table XI CE Angle in Subluxation-Hips

Age in years	Number of joints	Range of distribution	Average value
1	3	−4°～−15°	−9.7°
2	43	8°～−12°	−1.6°
3	83	11°～−17°	−1.7°
4	66	10°～−16°	−2.0°
5	34	7°～−11°	−1.2°
6	59	12°～−22°	0.4°
7	38	17°～−14°	2.8°
8～10	25	10°～−18°	1.0°
10～12	17	13°～−10°	3.2°
12～15	21	15°～−22°	−0.6°
15～20	18	16°～−22°	4.1°

Fig. 13 Scatter Diagram of CE Angle in "Normal" Hips



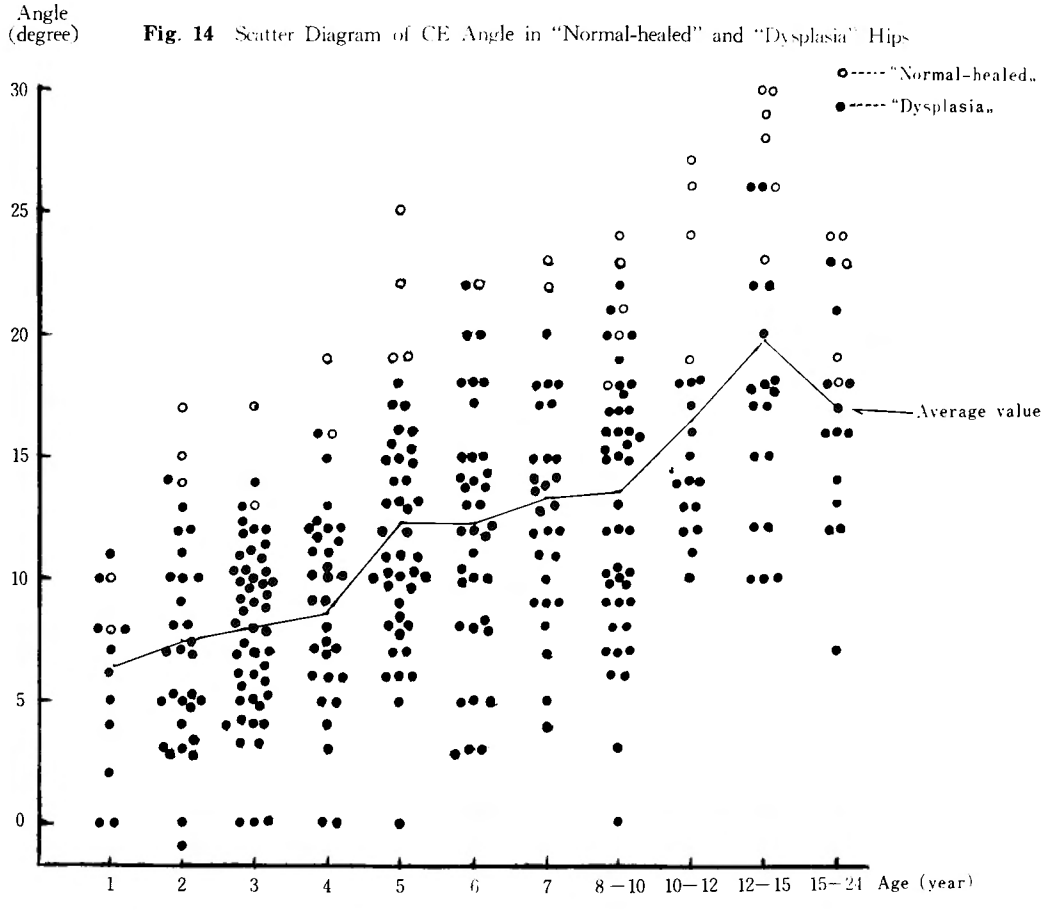


Fig. 14 Scatter Diagram of CE Angle in "Normal-healed" and "Dysplasia" Hips

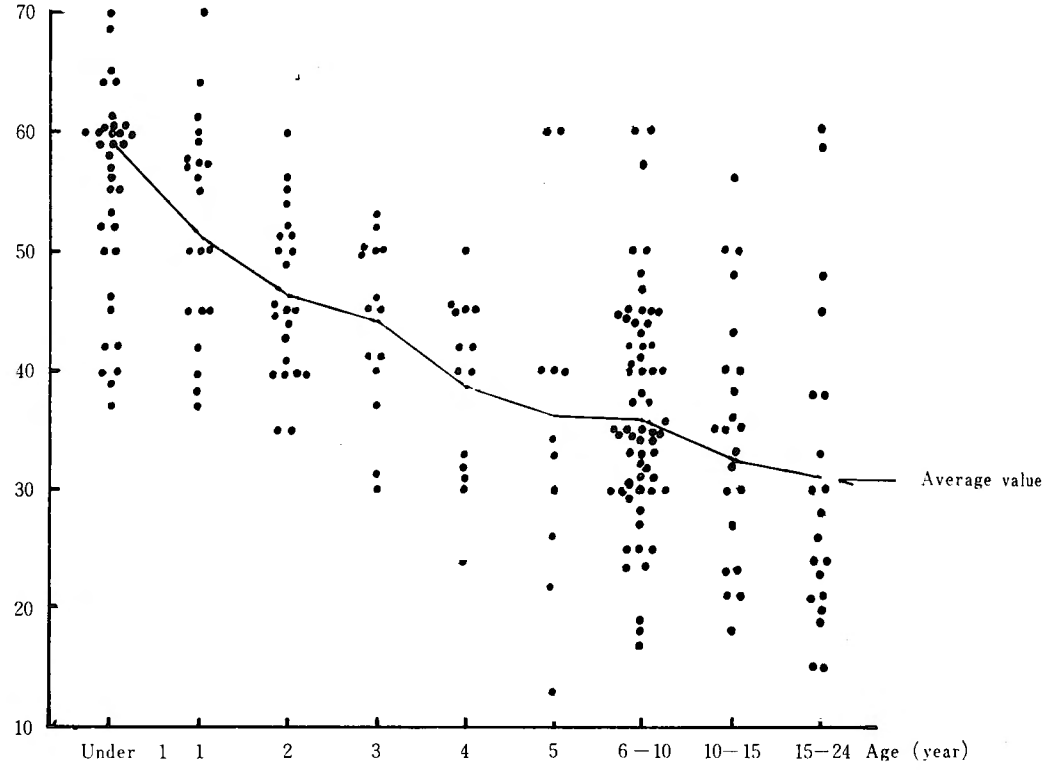
The antetorsion in the 233 "normal" hips ranged between 70° and 37° in those less than 1 year of age, and was 60° -13° in those over 2 years. The average value fell abruptly from 58° in those less than 1 year of age to 46° in 2 years and then decreased gradually until in those over 15 years, it was about 31° as shown in Fig. 15.

The antetorsion in 189 "normal-healed" and "dysplasia" hips showed a similar distribution, but the curve of the average value was irregular and a little higher (Fig. 16). The angle of "normal-healed" hips only, however, was less than 58° at 1 year of age, less than 50° after 2 years, and less than about 41° after 6 years of age.

In the subluxation-hips, the angle was much greater, but the curve of its average value, although in a higher level, resembled that of the "normal-healed" and "dysplasia" hips (Fig. 17).

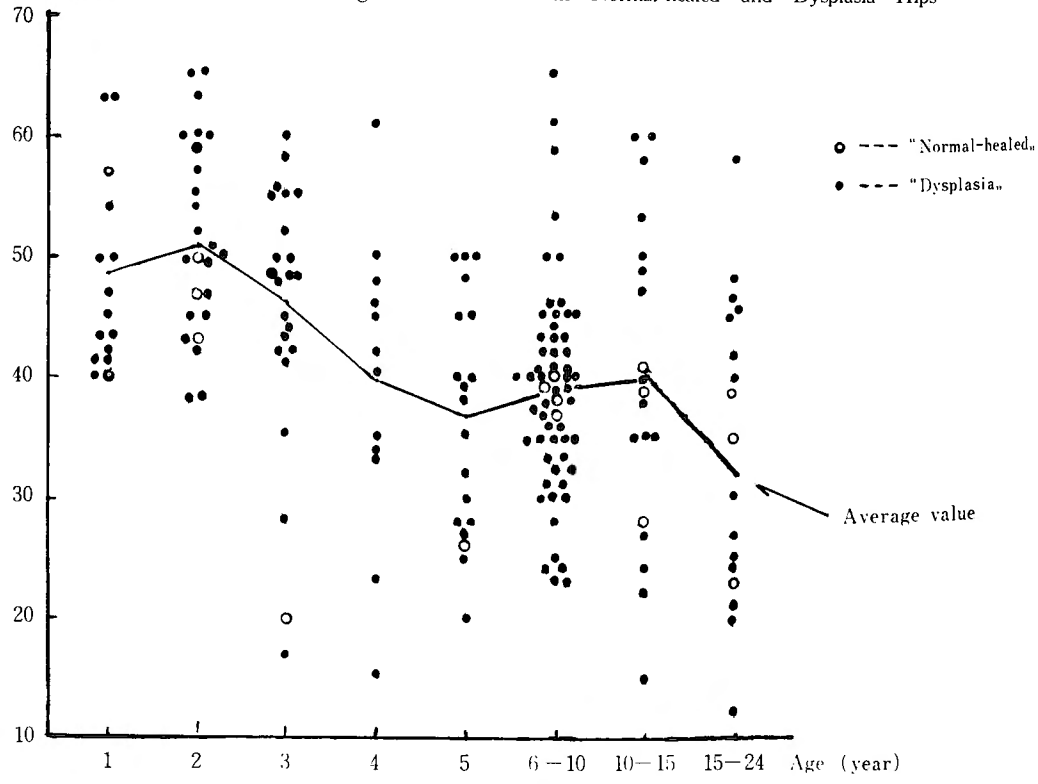
Antetorsion (degree)

Fig. 15 Scatter Diagram of Antetorsion in "Normal" Hips



Antetorsion (degree)

Fig. 16 Scatter Diagram of Antetorsion in "Normal-healed" and "Dysplasia" Hips



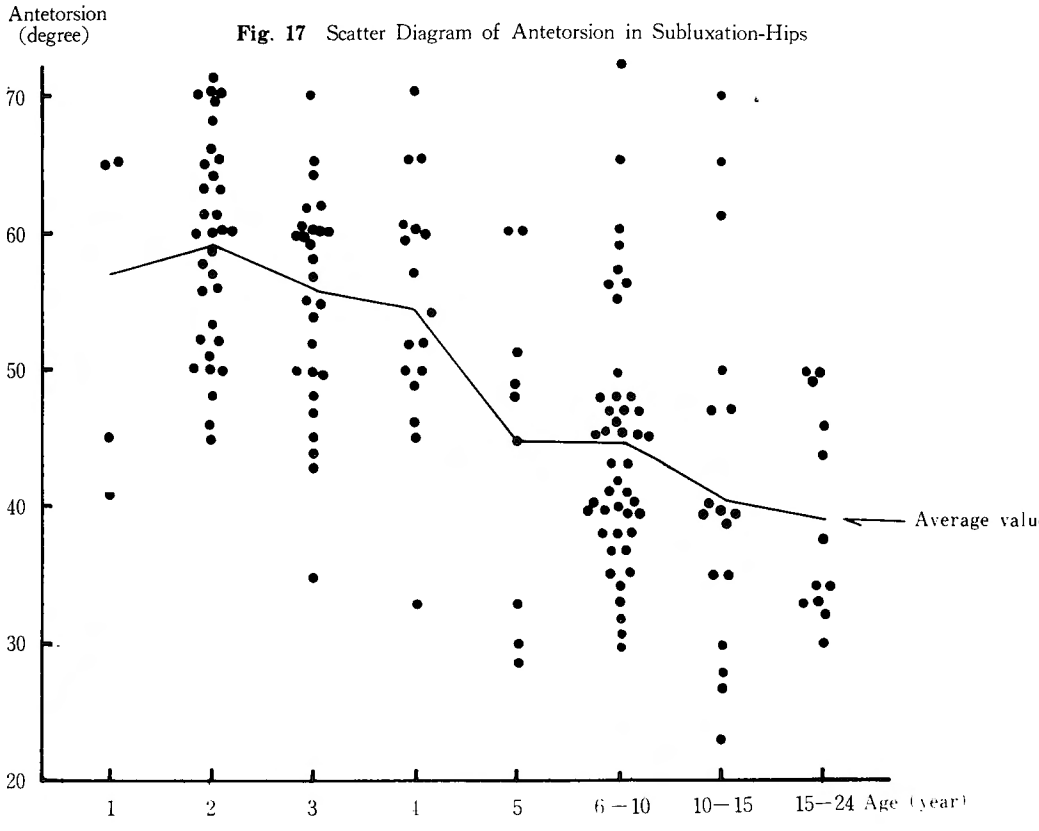


Fig. 17 Scatter Diagram of Antetorsion in Subluxation-Hips

Cervical Angle :

The cervical angle was measured in roentgenograms taken with the femur rotated maximally inward.

The cervical angle in 218 "normal" hips ranged between 158° and 127° in those under 1 year of age, 151° and 128° in those from 1 to 2 years, 143° and 121° in 3 to 9 years, 141° and 118° in 10 to 14 years, and 138° and 122° in those over 15 years. The curve of the average value fell considerably from 142° in those under 1 year of age to 137° in 1 year, then fell gradually until 15 years, when it was 129°, as shown in Fig. 18.

In the 209 "normal-healed" and "dysplasia" hips, the cervical angle renged between 151° anid 118°, and the curve of the average value was nearly horizontal (Fig. 19). In "normal-healed" hips, the angle remained within a narrow range (140°-124°).

In the 149 subluxation-hips, the cervical angle had a wide range (155°-100°) and the curve of the average value was very irregular (Fig. 20).

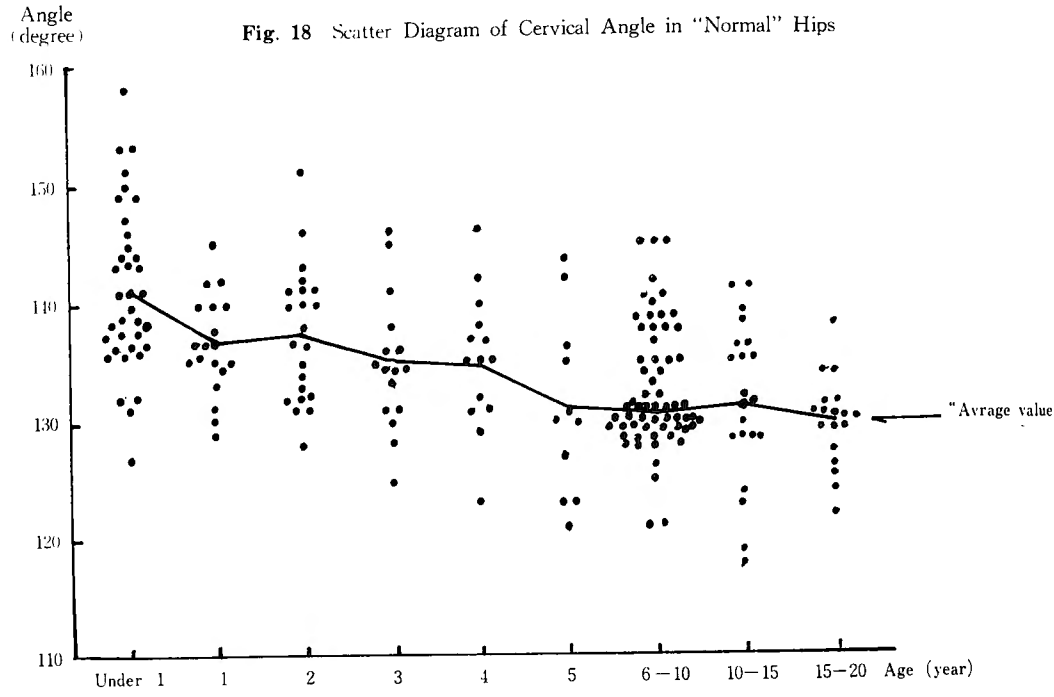
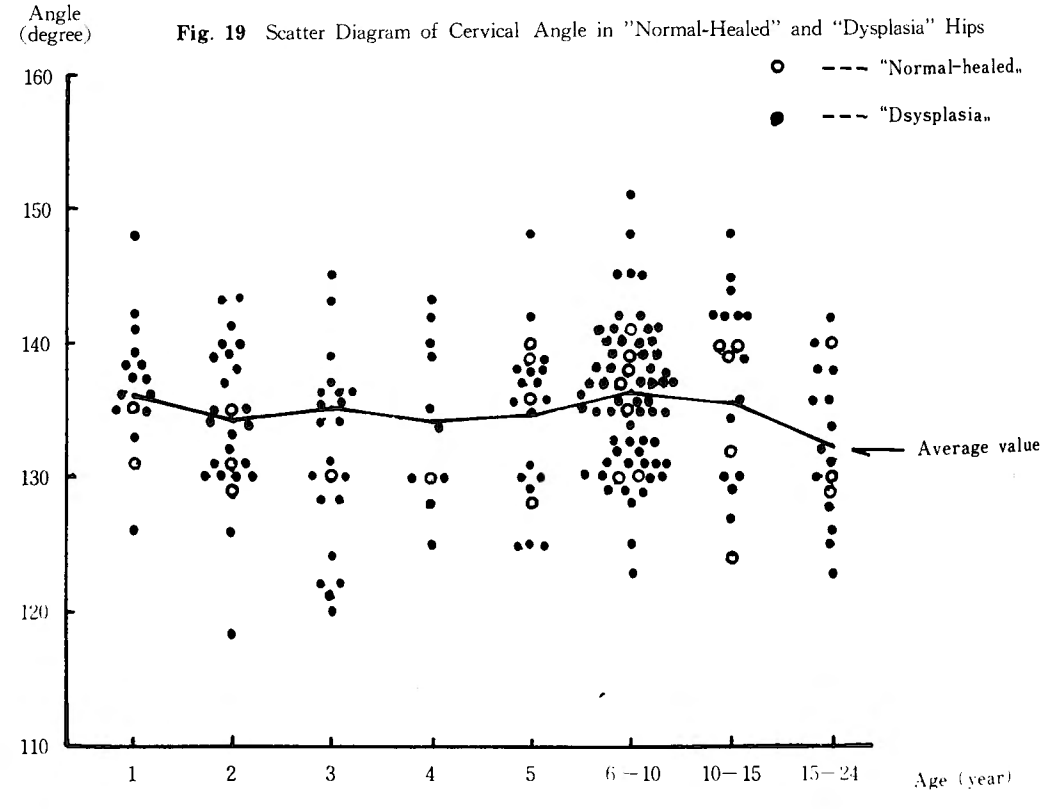


Fig. 19 Scatter Diagram of Cervical Angle in "Normal-Healed" and "Dysplasia" Hips



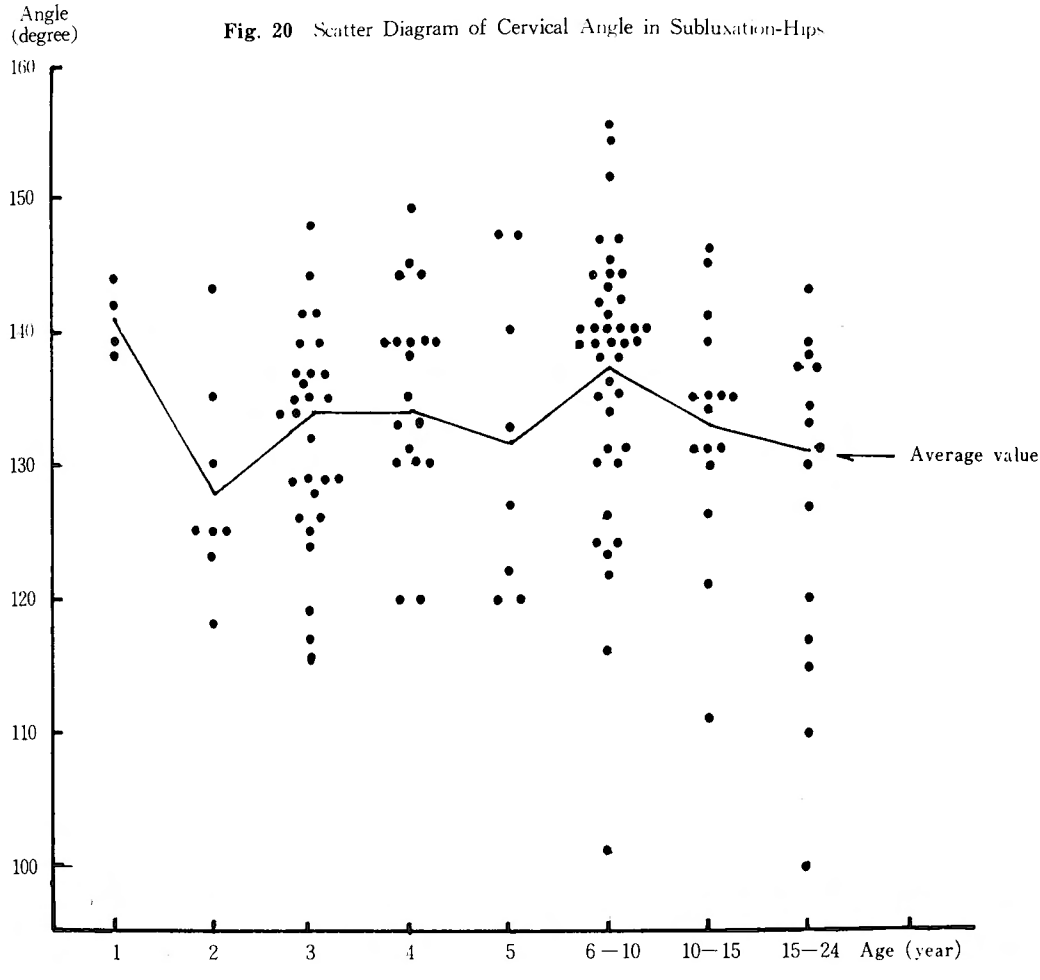


Fig. 20 Scatter Diagram of Cervical Angle in Subluxation-Hips

DISCUSSION

In recent ten years, significant advances have been made in the treatment of congenital dislocation of the hip. The most remarkable changes are that the disorder is now generally treated in the new-born and the surgery, as a prophylactic measure, is used when the results of primary treatment are unsatisfactory. Since our treatment of the disorder in the neonatal period started in 1962, and the prophylactic use of surgery in 1954, the results in these cases are not shown in this paper.

It is generally accepted that roentgenological results are poorer than clinical results. In this investigation, however, much greater differences were found between clinical and roentgenological results than noted in other reports. The clinical results were excellent or good in more than half of the joints reduced before 5 years of age (Fig. 4), while the roentgenological results were fair or poor in more than half of the joints reduced as early as at 1-2 years of age (Fig. 9). Moreover, a few excellent roentgenographic results were achieved in each age group. In the patients re-examined at 15 years of age or over, unsatisfactory results were found clinically in about 62 %, and roentgenographically in

about 72% of the joints (Tables VII and VIII). Therefore, the early or intermediate clinical results are of very little value, and roentgenograms should be evaluated more strictly than advocated by Severin. It may also be noted that the majority of hips treated conservatively will show some roentgenographic disorders in the future and that both the clinical and roentgenological results will become rapidly worse after puberty.

According to our investigation, the upper limit for closed reduction is 4 years of age, since almost no cases of roentgenographic healing were found among those in whom reduction was performed after 5 years of age (Fig. 9). Although the problem has become mainly theoretical because of the popularization of treatment in the neonatal period, we simply suggest the upper age limit of 4 years for prophylactic surgery. Our investigation also shows that indication for the prophylactic surgery will be considered in more than half of even those treated before 2 years of age, except for new-borns.

Avascular changes or osteochondritis of the femoral head were often found in cases in which reduction was performed in early infancy, as was reported by Petit. On the other hand, osteochondritic deformities ("Luxations-Perthes") of the femoral head developed in the majority of cases after period of fixation or when the patients started to walk. The data mentioned above suggest that avascular changes caused by the unnatural frog-leg position and long-term fixation are primary factors responsible for the osteochondritic deformity, and that secondary factors are traumatic injuries, in the wide sense, due to incomplete reduction because of so-called interposition, high acetabular obliquity, excessive antetorsion, etc.

Evaluation of the tendency to develop an acetabular roof during and after treatment is now the most important problem. Schede in 1925 suggested that the lower age limit for the shelf operation is 7 years since the acetabular roof could be expected to develop adequately in young children. However, this is a classical consideration prior to the introduction of the early shelf operation as a prophylactic procedure to prevent the development of the disorders which followed "dysplasia" and subluxation-hips. It was already proposed by Gill in 1935 that the shelf operation should be done at 2 years of age. Then M. Lange, in 1951, stated that the lower age limit for the shelf operation should be 4 years, since natural formation of the acetabulum could be expected up to 3 years of age. The natural formation of the acetabulum mentioned earlier articles, however, would be that of the 1st false cotyloid cavity depicted by Calot, and not the formation of the original cotyle. In 1962 M. Lange revised his opinion and stated that the shelf operation should generally be carried out at 3-4 years of age and the operation is definitely indicated when sclerosis appears in the upper acetabular roof. The "sclerosis" of the acetabular roof, a term used since Schede, is not sclerosis in the true sense of the term, but indicates a regular sharp contour of the image of the acetabular roof. If genuine sclerosis appears, it indicates already the development of osteoarthritic changes, by which time it would be too late to perform the prophylactic shelf operation.

To determine the indications for the prophylactic shelf operation, it is necessary to ascertain the present state of the osseous acetabular roof and its future development. For that evaluation, it is very helpful to measure the acetabular angle and the CE angle periodically. In "normal" hips, our investigation showed that the acetabular angle decreased

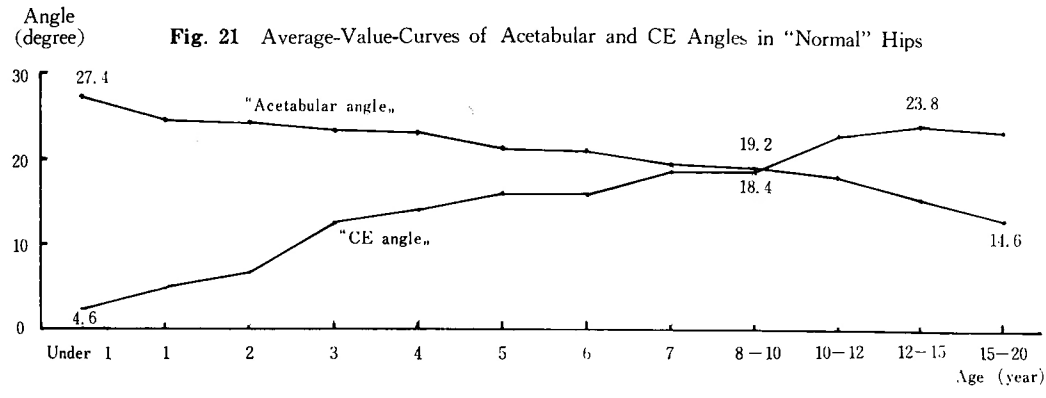
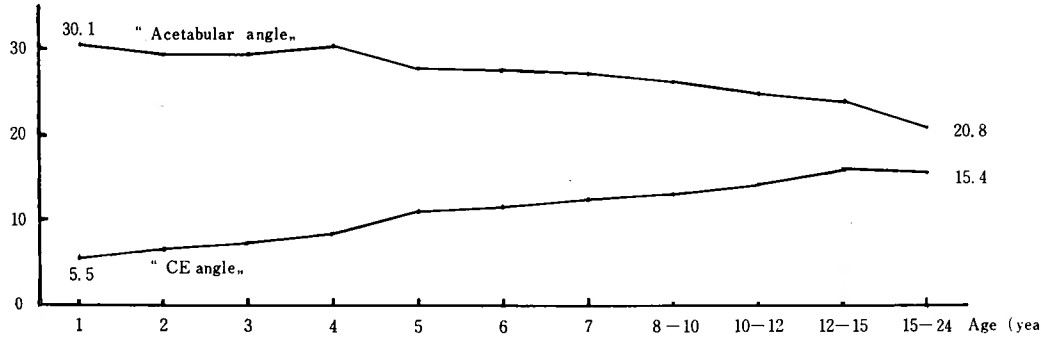


Fig. 22 Average-Value-Curves of Acetabular and CE Angles in "Dysplasia" Hips



and the CE angle increases with age. Then the curves of the average value of the two angles run symmetrically and cross each other at about 9 years of age (Fig. 21). In "dysplasia" hips, however, the two curves do not cross each other (Fig. 22). Moreover, the CE angle of subluxation-hips is essentially different from that of "normal" or "dysplasia" hips, since the femoral head of subluxation-hips is always situated in the 1st false acetabular cavity, and the CE angle is not only related to the obliquity of the acetabular roof, but also to the interposition, antetorsion, femoral head deformity, etc. In other words, the CE angle does not always indicate acetabular formation. The acetabular angle is, therefore, the most important indicator for the application of the shelf operation, and the CE angle is only supplementary.

The curves of the average value of the acetabular angles are compared with the results of treatment in Fig. 23. It is shown that the prophylactic shelf operation is indicated within 2 years of age, since the curve of "dysplasia" hips is nearly horizontal up to 4 years of age, and the value of "dysplasia" hips is higher than that of "normal" hips in 4°-7°. On the contrary, the curve of subluxation-hips rises from 1 year of age (about 33°) to 4 years (about 36°). The actual indications for the shelf operation should be determined individually, but the distribution and average-value-curve of the acetabular angles revealed that it is indicated if the acetabular angle is over 30° within 2 years of age.

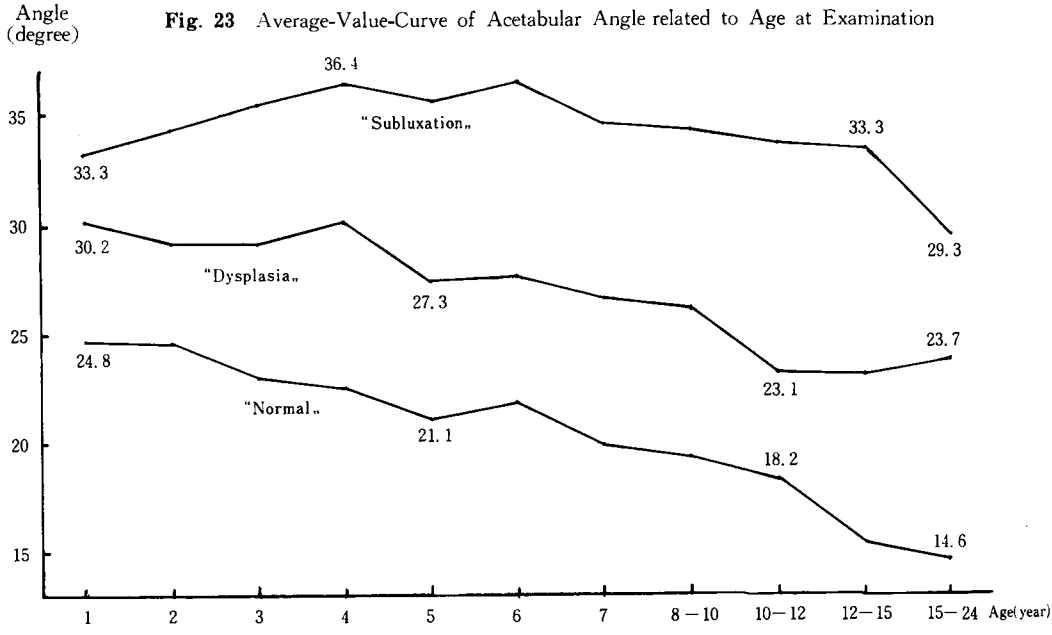


Fig. 23 Average-Value-Curve of Acetabular Angle related to Age at Examination

The antetorsion of the femoral neck is usually 5° in the 3rd embryonal month and then gradually increases up to a maximum of 31° at delivery (Altmann). Lanz revealed that the average value of antetorsion decreases after delivery, i.e., 30° at 1 year of age, 20° at 3-6 years, 18° at 10-14 years, 14° at 15-20 years and about 12° in adults. In females it is larger than in males. Our roentgenological measurements showed the average value of antetorsion be about 19° in the normal hips of Japanese females at 18-20 years of age. The degree of antetorsion showed a very wide range of distribution from 10° to 65°, and its average value decreased in proportion to the increase of age not only in "normal" hips, but also in "dysplasia" and subluxation-hips (Fig. 24). Therefore, we do not agree with some othors that indications for rotation osteotomy should be based only on the antetorsion value. However, rotation osteotomy should be performed in cases of subluxation with antetorsion of over 50° in patients under 2 years of age and of over 45° in those under 5 years.

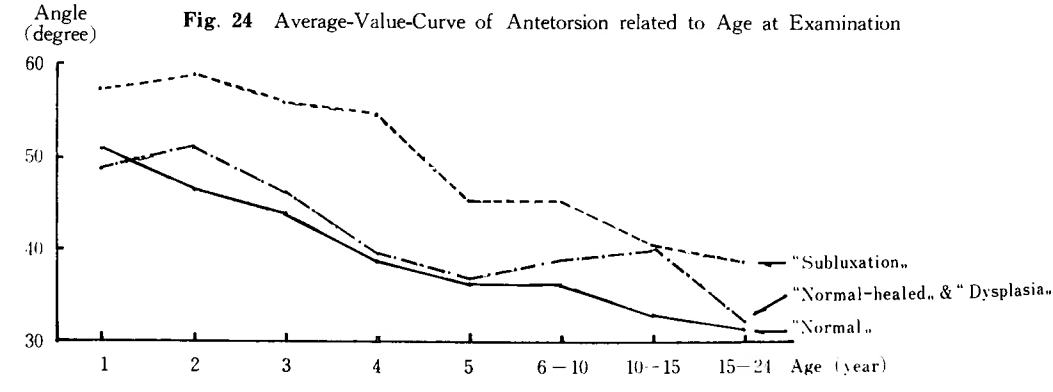


Fig. 24 Average-Value-Curve of Antetorsion related to Age at Examination

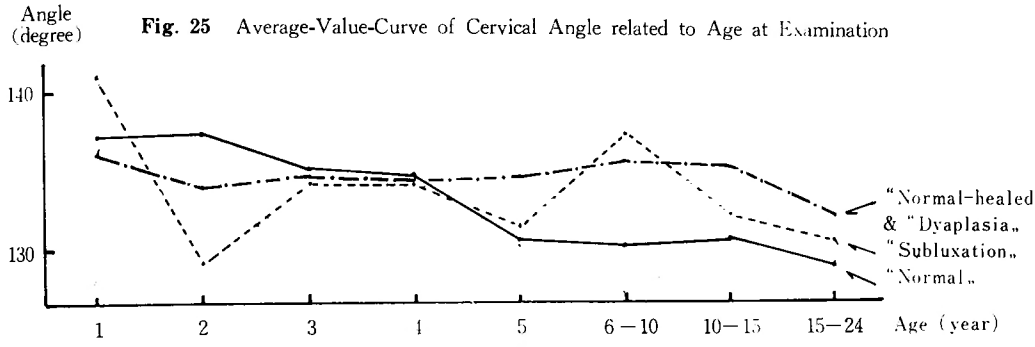


Fig. 25 Average-Value-Curve of Cervical Angle related to Age at Examination

The average value of the cervical angle is 144° in 1-2 years of age and gradually decreases to 126° in adults (Lanz). In our investigation, the average value in "normal" hips was 136° in 1 year of age and 130° in those over 15 years of age; its distribution showed a range of 158°-118°. Although the cervical angle of subluxation-hips was widely distributed from 155° to 100°, its average value showed only a little deviation from 141° to 131° (Fig. 25). Therefore, the operative correction of the cervical angle is not necessarily performed as a single porcedure in young infants. However, it would be preferable to combine it with rotation osteotomy for the prevention of valgus deformity developing after surgery.

SUMMARY

The results of conservative treatment of 585 patients with congenital dislocation of 904 hips which had been treated by closed reduction at Kyoto University Hospital during the period from 1940 to 1955 have been reviewed, and the indications for prophylactic surgery in cases with unsatisfactory results are discussed.

1) In 504 (86.3%) of the cases reviewed reduction was performed before 3 years of age, in 322 (55%) before 2 years, and in only 35 (6%) before 1 year. The period from initial treatment to re-examination was 1-19 years, and the patients were 1-24 years old at the time of re-examination; the majority (90.5%) were under 15 years of age.

2) Clinical results were excellent and good over 64.1% of those under 15 years of age, but were fair and poor in 61.5% of those over 15 years of age.

3) Roentgenological results were much poorer than clinical. Although it is generally accepted that the younger the age of primary treatment the better the results, fair and poor results were found in 36% of those treated under 1 year of age and in 62% of those 1-2 years of age. Moreover, re-examination revealed subluxation, dislocation or severe deformity of the femoral head in 52%, already, at 1-2 years of age, and in 73% after 15 years of age. Therefore, prophylactic surgery is indicated in half of the treated cases in order to prevent later development of the osteoarthritis of the hips.

4) The indications for prophylactic shelf operation can be determined already at the age of 1-2 years, when we take into the consideration the distribution of the acetabular angle and the transition of its mean value. If the acetabular angle is 30° or more operation is indicated. The indication for rotation osteotomy in younger infants cannot be decided on the basis of the antetorsion value alone. The operation should be performed only for subluxation with antetorsion of more than 50° at the age of 1-2 years and of

over 45° in those under 5 years of age. The operative correction of the cervical angle is not necessarily performed as a single procedure in young infants. However, it is preferable to combine it with rotation osteotomy for the prevention of valgus deformity developing after surgery.

5) Avascular changes or osteochondritis of the femoral head were frequent after reduction in early infancy, and develop after the period of fixation in the majority of cases. Therefore, avascular changes due to unnatural frog-leg position and long-term fixation are probably as primary factors for osteochondritic deformity ("Luxations-Perthes"), while traumatic injuries, in the wide sense, are secondary factors.

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先天股脱に対する非観血的治療の成績

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1940年から1955年にわたる15年間に京大整形外科において保存的療法を受けた先天性股脱児について，治療終了後1～22年における成績を系統的に調査し，治療実数の56.9%に相当する585例・904関節において臨床並びにレ線学的検査を実施することができた．また股関節のレ線学的計測値を中心に検討を行い，成績不良の症例に対する予防的補正手術の適応範囲およびその適応年令の決定に関し考察を加えた．

1. 調査例中504 (86.3%) は3才未満の整復例，また322(55%)は1才台における整復例であり，1才未満の整復例はわずかに35（6%）であった．初療から調査までの経過年数は1～22年，また調査時の患者の年令は1～24才で，その中の90.5%は15才未満である．

2. 臨床的成績は，14才までは優・良例が過半数を占めるが，思春期前後から自覚的および他覚的に何らかの障害を来す症例が増加し，15才以後になるとその比率は逆転して可・不可例が過半数に達する．

3. レ線学的成績は臨床的成績に比し著明に悪く，一般的に初療時年令の若いものほど良好な成績を示すが，すでに1才未満の整復例においても36%，1および2才の整復例では62%に可・不可例が見出された．また調査時年令別にみても，1および2才ですでに可・不可例すなわち骨頭の転位と変形を伴う臼蓋形成不全が25%に見出され，15才以後になるとそれが73%に達した．したがって，早期治療例においても，その約半数において，2次的変形性関節症防止を目的とする予防的補正手術について適応の有無を慎重に考慮すべきである．

4. 臼蓋角，CE角，前捻角および頸体角は，いわゆる正常側関節においては，いずれもその分布および平均値にそれぞれの年令に応じた規則正しい変化が示され，また骨頭転位を伴わぬ臼蓋形成不全例においても，それぞれその平均値は異なるが，大体において正常側に近いパタンを現わす．これに反し，亜脱臼例においてはこれと大いに趣きを異にし，分布の範囲は広く，その平均値曲線はきわめて不規則であった．

5. 予防的臼蓋形成術は，α角の分布範囲およびその平均値の年令的推移からみて，その適応決定はすでに1～2才の時期において可能であり，この時期における手術の応用は30°以上のα角を示すものから選ぶべきである．減捻骨切り術の適応は，前捻角値のみによって決定することは無謀であり，幼若児においては前捻角45°以上の亜脱臼例に限定すべきである．また頸体角の矯正手術は，これを単独に幼年児に行う必要は一般的には認め難く，転子間あるいは転子下骨切り術後に外反股の発生を見ることが少くないので，減捻骨切り術を施す場合，同時に頸体角を120°程度に減ずることが望ましい．

6. 阻血性骨頭変化ないし脱臼性骨軟骨炎は，整復年令の若いものにより多く見出され，かつその大多数は固定終了後に発生した．したがって，脱臼性骨軟骨炎（Luxations-Perthes）は整復による機械的障害よりもむしろ長期間の画一的固定肢位による阻血性骨頭変化を1次的因子とし，固定期間中ないしその後における広義の外傷を2次的因子として発生するものと考えたい．